USAARL Report No. 95-11

Manikin Integrated Data Acquisition (MIDAS) Initial Modifications

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December 1994

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION: Unclassified

1b. RESTRICTIVE MARKINGS:

2a. SECURITY CLASSIFICATION AUTHORITY:

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE:

3. DISTRIBUTION / AVAILABILITY OF REPORT: Approved for public release, distribution unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S): USAARL Report No. 95-11

5. MONITORING ORGANIZATION REPORT NUMBER(S):

6a. NAME OF PERFORMING ORGANIZATION: U.S. Army Aeromedical Research Laboratory

6b. OFFICE SYMBOL (If applicable): SGRD-UAD-IV

7a. NAME OF MONITORING ORGANIZATION: U.S. Army Medical Research and Materiel Command (Provisional)

6c. ADDRESS (City, State, and ZIP Code): P.O. Box 620577, Fort Rucker, AL 36362-0577

7b. ADDRESS (City, State, and ZIP Code): Fort Detrick, Frederick, MD 21702-5012

8a. NAME OF FUNDING / SPONSORING ORGANIZATION:

8b. OFFICE SYMBOL (If applicable):

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER:

8c. ADDRESS (City, State, and ZIP Code):

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
62787A 30	162787A878	ED	141

11. TITLE (Include Security Classification): Manikin integrated data acquisition system (MIDAS) initial modifications

12. PERSONAL AUTHOR(S): Nabih M. Alem, James A. Lewis, and Robert M. Dillard

13a. TYPE OF REPORT: Final

13b. TIME COVERED: FROM ______ TO ______

14. DATE OF REPORT (Year, Month, Day): 1994 December

15. PAGE COUNT: 25

16. SUPPLEMENTARY NOTATION:

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
15	05	
05	09	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): prototype, manikin, crash testing, data acquisition, anthropomorphic test device, injury assessment

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A prototype manikin with internal data acquisition system (MIDAS) has been developed and received by the US Army Aeromedical Research Laboratory. In addition to a novel design of the spinal column and pelvis of the Hybrid III automotive manikin, the new MIDAS includes a built-in signal conditioning and acquisition electronics. This report documents the initial modifications to the manikin and includes a description of the external software (MIDAS 3.0) for control, communication, and posttest downloading and analysis of the data.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT: ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION: Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL: Chief, Science Support Center

22b. TELEPHONE (Include Area Code): 205-255-6907

22c. OFFICE SYMBOL: SGRD-UAX-SI

DD Form 1473, JUN 86 — Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

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Introduction

A prototype manikin with internal data acquisition system (MIDAS) has been developed and received by the U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, Alabama, for initial evaluations. New features in this anthropomorphic manikin include a novel design of the spinal column that offers more flexibility in compression and twisting than other manikins, a pelvis that contains the signal conditioning and data acquisition electronics required in most impact tests, and two new upper legs where rechargeable nickel-cadmium cells are placed to provide power supply for the instrumentation and data acquisition system.

As with most prototype systems, MIDAS must be evaluated before it can be put to full use in crash tests and other impact exposures. The evaluation process is simple: expose the manikin to impact tests, collect its biodynamic response signals, then compare the impact response to that of other validated manikins such as the original Hybrid III. This requires that the MIDAS internal electronics and data acquisition system operate properly and allow the data to be extracted in a short time.

Initial bench testing of MIDAS's signal conditioning electronics pointed out areas of potential problems which must be addressed prior to any sled or field testing. First, the battery packs which were installed in the manikin femurs were not supplying adequate power to the electronics. Additionally, the power supply that runs off the standard 120 VAC line and which was delivered with the prototype introduced unacceptable levels of noise to the signal amplifiers. Therefore, a new power supply was needed to replace the current battery packs and provide power from an external source through an umbilical line.

The second area where difficulties were encountered was the software for data acquisition, downloading, and display, which was delivered with the system. Since our immediate goal was the evaluation of the biodynamic response, it was essential that we are able to modify the internal settings of the electronics and to immediately examine the data captured after each test for quick assessment of the manikin performance. Our bench tests also pointed out the need for reliable and flexible software which allows us to achieve these two simple goals: modify the settings and examine the data as quickly as possible.

This report is intended to document the initial improvements made to the MIDAS prototype since its delivery. Because it was only a prototype, modifications were made only to bring the manikin to an acceptable level of reliability during sled tests.

Materials and methods

Electronics hardware

The external power supply was designed to convert 120 VAC to provide several regulated DC voltages to MIDAS's internal computer CPU, memory, disks, transducers, and amplifiers. The box delivered with the manikin had to be reworked by first removing the battery charger subsystem from the power supply box itself. Second, the soldering joints of the cables had to be redone because of potential breakage during anticipated sled mounting of the power supply box.

A serious problem that was identified after extensive debugging was the so-called "common mode problem." This problem caused the signal amplifiers to saturate due to the transducer excitation being tied to system ground. The problem was corrected by floating (relative to system ground) the 15-Volt excitation voltage of each transducer power supply.

Another shortcoming was cumbersome access to the analog signals from the 24 transducers installed in the manikin. Access to these signals is necessary for debugging and maintenance, for bypassing the data acquisition system in case of failure, and for recording the analog signals on an external data recording medium. At one stage during the development and testing of MIDAS, the contractor has built into the wiring access to all the transducer signals. Since this was not part of the contract and because of space constraints, the access cables were removed. In order for USAARL to make its evaluation, it was necessary to reconstruct the access cable and connect it to a breakout box where BNC-type connectors may be used. This proved later to be a valuable modification when it became necessary to record the signals external to the MIDAS hardware.

Data acquisition settings

Precise measurements require accurate knowledge and control of the sampling rate and the gains for each amplifier in the manikin internal data acquisition system. Therefore, it was essential to verify the values of sampling rate and gains claimed by the contractor. We used the voltage insertion method, where a low level sine wave signal, generated by a precision calibrator, was used to replace a transducer and provide an input to the amplifier. By measuring the output of the amplifier, we determined its actual gain as the ratio of its output over the input, and its zero offset as the midpoint of the peak-to-peak range of the output.

Although it was possible to determine the amplifiers' gains by monitoring analog input and output signals, it was necessary to determine the sampling rate of the A/D convertor from the digitized data after it was stored on the thin credit-card memory, then dumped onto a PC disk file and examined. This was done after the first version of the MIDAS software became operational.

External software

As delivered, the operation of MIDAS requires the user to turn on the power supply, modify the amplifier gains and other data acquisition parameters to accommodate specific test conditions, conduct the tests, then remove the credit-card memory module (where the manikin internal computer stored the data) for down-loading and analysis of the digitized data. A new MIDAS program was written to externally control the amplifier settings and sampling rate, and to extract the data from the credit-card and display it for quick look and assessment of the quality of the data acquisition.

Because of its intended use, the MIDAS program was designed to improve the communication by automating most of the functions which were required to be repeated by the user. The program was written in Fortran language (Microsoft Corp, 1988) to be run on an IBM-PC computer under a MS-DOS environment. All test data would be downloaded and archived along with descriptive and calibration data. These archived files may be accessed by MIDAS for further analysis and plotting at a later time after completing a test series. The program produces hard copies of raw and processed signals and summaries of analyzed signals. The program offered significant improvements in the operation of the manikin and, although several additions were contemplated, the first version was deemed adequate for evaluating the results from sled tests.

Results

The bench evaluation of the electronics, wiring, and data acquisition system produced the following observations. Refer to Frisch, Boulay, and Alem, 1994, for a description of the delivered MIDAS and explanation of the components mentioned here.

1. The signal conditioner circuitry has no offset capability. Potentiometers on the board that are connected to the sample-and-hold (S/H) amplifiers have no effect on the direct analog or S/H output.

2. The voltage substitution calibration, as currently provided, is not useful. The resistor calibration (RCAL) is not implemented.

3. Gain and sample rate settings cannot be verified and sometimes are in error. Occasionally the gain sets to gain code 0, and at other times the sample rate sets to lowest value, as evidenced by a very dim data card light-emitting diode (LED).

4. For proper operation of the sensors, the power supplies required rewiring to "float" the grounds. The following supplies were affected: +15 volts for all of the accelerometers, +15 volts for all of the load cells, and +10 volts for the angular accelerometer in the head.

5. The specified rates for sampling are only approximate values.

6. Sampling at the highest two rates, 5 kilo-Hertz (KHz) and 10 KHz, is not possible with the current system which writes 48 channels to the data card.

7. The manikin's internal wiring harness is difficult to check or correct. It should have been of a more replaceable design, so that sensors or cables could be replaced easily. The copper tape shielding is ineffective.

8. The definitions of channels 18 and 20 appear to be swapped from their original designations.

9. Several signal conditioner hybrid circuits are bad, in one or both channels of the hybrid.

10. The L5 load cell channels have noise problems; so do the Head-X and the T1-Y channels.

11. Channel 19 is nonfunctional, producing a 147 Hertz noise signal.

12. Signal conditioner module card #1 has bad U-11 chip.

External software (MIDAS 3.0)

The MIDAS software initially was written to replace the software delivered as part of the contract because that software did not allow sufficient flexibility and reliability in operating the manikin, nor adequate speed in downloading and examining the acquired data. The latest version of MIDAS (version 3.0) was the result of actual tests and experience in the manikin's operation as intensive bench testing was conducted.

The step-by-step procedure to operate the manikin is summarized in Appendix A. This requires the MIDAS software and a PC connected through an RS-232 cable to the manikin internal computer. The capabilities of the MIDAS (version 3.0) software are summarized in Appendix B in the form of a series of screen printouts of the program menus. Although shown in black and white, these "screens" are produced on a VGA monitor in colors which are used for emphasis of key words or important text, and for demarcation between blocks of information. The following features are the highlights of the software.

1. The program consists of over 200 subroutines, written in Microsoft Fortran 5 and developed in its entirety at USAARL.

2. The program is interactive when necessary and automated when possible, and is entirely menu driven. All of the major submenus in MIDAS are reproduced in Appendix A as screen printouts.

3. The program requires an IBM-PC compatible running MS-DOS 5.0 or higher.

4. The PC hardware should have a VGA color monitor, although a laptop LCD screen may be used after adjusting the "color" settings to suit the particular screen.

5. No mouse is needed but a serial port (COM1 or COM2) must be available to communicate with the manikin internal computer.

6. MIDAS software is designed to run independent of the manikin to analyze, plot, and produce hard copies of the analyzed data after all the data from a series of tests have been archived.

7. Hard copies are produced in PCL/5 and HP-GL/2 languages and require printers capable of interpreting these languages, such as the HP Laserjet 3 or 4.

Discussion

As with most prototype systems, some adjustments to the delivered version of the system was necessary. The initial modifications were designed primarily to put the manikin in an acceptable and reliable working condition so its performance as a test device could be evaluated. The reliability of the power supply, the calibration of the amplifiers, and the identification and repair (when possible) of known problems were of the utmost concern. Just as critical was the down-load and quick-look capability without which the manikin simply could not have been tested efficiently.

The manikin was designed to be self contained, i.e., capable of operation from an internal power source. The design of the prototype included two sets of nickel-cadmium (nicad) batteries installed in the femur in two cylindrical arrays. Although this approach was discussed and approved during the development phase of the manikin, the execution of this design by a subcontractor resulted in a product that functioned below our expectations. A remedy to this problem was set aside while more important issues were addressed. Thus, the manikin was to operate from external power supply until the internal battery supply issue has been resolved. Indeed, an external power supply was delivered but it also had problems: noise, ground loops, poor shielding, weak soldering connections and unnecessary wiring. All these problem areas were addressed and resolved in the more reliable configuration which was fabricated. This allowed us to advance to the next stage in this research program: the actual sled and controlled drop tests.

Equally important was our ability to program the internal amplifiers' gains and adjust the sampling rate of the manikin data acquisition system to meet the different impact test requirements. The manikin had default settings for all amplifiers and sampling rate which were stored on an erasable/programmable ROM chip in the MIDAS computer and read each time the manikin was turned on. Access to these stored defaults required the "undressing" of the manikin

and the removal of the CPU board, then its installation in a separate but equivalent computer for re-coding. The alternative to this time-consuming task was the transmittal of the desired gain values over the serial communication port every time the manikin was turned on to override the default values.

This approach was an acceptable solution if all goes well. Unfortunately, it took nearly half an hour of interaction between the user and the manikin internal software before the new settings had been transmitted. Frequently, the transmittal was so erratic because of poor COM port hardware and software drivers or because of unexplainable malfunction in the MIDAS internal electronics that it was necessary to reset the internal electronics by turning off the manikin power supply then switching it back on to restart the entire operation. This frustrating and inefficient process was one of the two primary reasons for writing our own external MIDAS control software.

The other motive for rewriting the MIDAS software was our inability to examine the data immediately after it was acquired. This essential requirement was somewhat met by the software as it was delivered. In fact, we were able to quickly remove the credit card and "download" the raw data to a PC file using utilities supplied by the manufacturer of the credit card. Unfortunately, plotting one impact pulse, which may be of 20 or 30 millisecond duration, required the manual plotting of the entire channel signal (1200 msec) in small segments and, when all segments were finally plotted, did not give the user sufficient timing and magnitude information to judge the quality of the test. The tedious process was lengthy and often was abandoned after examining one or two channels inconclusively.

Therefore, the MIDAS program was designed to truly assist the user in making informed decisions regarding a test. Just as the manikin could not have been operated without a reliable power supply, it would have been unwise to operate this new prototype without the benefit of "quick look" and "hard copy" capabilities.

Summary and conclusions

As with most prototypes, initial modifications were necessary to the hardware and the software delivered with the manikin in order to bring it to an acceptable operating status. These include improvements to the external power supply to be used temporarily in lieu of the internal battery system, and a PC-based program (MIDAS) which facilitates the settings of internal amplifiers gains and sampling rate, and allows quick look at the down-loaded data immediately following a test. Eventually, it will be necessary to redesign the internal battery-based power supply so that field tests can be conducted independent of external connections. Also, it will be necessary to modify the internal data acquisition software to improve serial communication and to allow easier modification and retention of default data acquisition parameters.

<u>References</u>

Frisch, P., Boulay, W., and Alem, N. 1994. <u>Design and development of an enhanced biodynamic manikin</u>. Phase I report for contract DAMD17-90-C-0116. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL contractor report No. CR 94-1.

Microsoft Corporation. 1989. <u>Fortran reference manual, version 5.0 for MS-DOS operating systems</u>.

Appendix A.

MANIKIN operating procedures.

1. Connect RS-232 cable between manikin and PC communications port 1 or 2, as set in the USAARL manikin integrated data acquisition system (MIDAS) program.

2. Install the memory module (credit-card) into the manikin chassis slot.

3. Power-up manikin. The green LED on control unit indicates +5 volt power is present. Wait approximately 20 seconds - a short flash of the red LED indicates end of boot sequence.

4. On PC, run the MIDAS program. Verify sample rate in the "Sampling setup" function, gains and correction factors in "Amplifiers" function, and sensitivities in "Transducers" function.

5. Using "Identify test" function, enter the new test ID and other desired information.

6. Use the "Manikin controls" function to send gains and sample rate (press F1). If manikin will not respond, send "escape" characters (press F8) to clear the communications port. If this doesn't help, check for correct communication settings under the "Colors and comm." section, set port at 1200 baud, 8 bits, no parity, and 1 stop bit. Verify cabling is connected to correct port. Manikin uses upper communications port connector on manikin input/output (I/O) card, which is located inside the rib cage.

7. "Arm" manikin when ready (press F9). Observe that red LED is on and bright. A dim LED indicates improper sample rate. If LED goes off after 6 seconds (at 2500 Hz sample rate) or after 16 seconds (at 1000 Hz sample rate), then a false trigger has occurred. Turn off manikin power, ensure trigger signal is at ground potential (0 volts), and reapply power to manikin. Resend sample rate and gains after manikin boots up. A steady on LED indicates the proper "armed" condition (data is being written to the card in a circular buffer).

8. Disconnect the RS-232 cable from the manikin.

9. Run test. A 0-to-5 volt transition on the trigger signal input will end the 200-points/channel circular buffer and start the post-trigger data recording. When the red LED goes out, the 12,000 post-trigger data points/channel have been written to the card (storage complete).

10. Remove data card. Insert data card in the PC, perform "Backup card data" operation, saving the card image to hard disk. Use "Extract signals" to retrieve data from the data card (or from a saved file). Use the "Process" function to view signals.

11. Turn off manikin power if done, or press RESET and go to step 2 for the next test.

Appendix B

External manikin software.

MIDAS version 3.0.

This appendix contains screen printouts of most menus and sub-menus which are available in the MIDAS program. Because they are printed in black and white, much of the color highlights used to emphasize various key words and text, and to separate blocks of information on the screen are, of course, missing. However, these "screens" do provide a printed documentation in lieu of actually running the MIDAS program itself.

```
Test:  LX65-56      MIDAS-3.0   Manikin Integrated DAS        13:01:03

Identify test
Extract signals           Data ID/Label:  LX65-56
Process signals
                         Description of data:
Sampling setup
                         Dynamic testing of MIDAS prototype crash manikin
Define channels
                         Sled acceleration pulse:  10.3 peak G, 23.1 mph
Amplifiers
                         Seat pitch:  +35 degrees
Transducers
Backup card data
Manikin controls
Colors and comm.
                         Identify test data with a unique label to be used in
Quit to DOS              naming binary and exchange data files.  Descriptive
                         text may also be added to identify test conditions.
```

Figure B-1. Screen printout of the test identification menu which allows the user to enter a test label and additional comment associated with the test.

```
  Test:  LX65-56      MIDAS-3.0   Manikin Integrated DAS        13:06:32

  Identify test       F1   EXTRACT data from THINCARD      20 signals
                           into RAM, and store them in
► Extract signals          MIDAS Internal Format on file   LX65-56.MIF

  Process signals     F2   SELECT from listed files ==►    LX65-56.MIF
                           the name and type of MIDAS      LX65-55.MIF
  Sampling setup           file to retrieve from disk      LX65-52.MIF
                                                           LX65-45.MIF
  Define channels     F3   RETRIEVE the selected .MIF      LX65-44.MIF
                           disk file into RAM memory.      LX65-43.MIF
  Amplifiers

  Transducers         F4   RESTORE data from 3 backup      LX65-56.ini
                           files now on directory          LX65-56.pre
  Backup card data         C:\NBDL\BACK\                   LX65-56.dat

  Manikin controls    F5   EXPORT data to text file:       LX65-56.MXP

  Colors and comm.
                      Extract data from CC memory and save on hard disk in
  Quit to DOS         the desired format.  Retrieve binary files from hard
                      disk for plotting or export in another format.
```

Figure B-2. Screen printout of the data extraction menu where the user selects the source and destination of the data to be extracted.

```
Test:  LX65-56        MIDAS-3.0   Manikin Integrated DAS        13:06:57

  Identify test            F1     Raw channels
  Extract signals          F2     Test/channel information
▶ Process signals          F3     [3] Integral/derivative
  Sampling setup           F4     [2] Over-plot signals
  Define channels          F5     [3] Integral/derivative
  Amplifiers               F6     [6] Head triax & HIC
  Transducers              F7     [5] Triax and resultant
  Backup card data         F8     [5] Triax and resultant
  Manikin controls         F10    VGA:  640x480, 80x30
  Colors and comm.
  Quit to DOS           Plot signals for screen quick look or hardcopy print.
                        To print, LaserJet III printer port must already be
                        defined with the DOS PRINT command.
```

Figure B-3. Screen printout of the data processing and analysis menu. This menu opens several submenus where various types of signal analyses are allowed.

```
Test:  LX65-56        MIDAS-3.0   Manikin Integrated DAS        13:07:29

  Identify test          Sampling rate:   2500.0  Hz/channel (nominal)
                                Actual:   2512.5  Hz per channel
  Extract signals                           .398  msec  interval

  Process signals        Sampling rate must match rate sent to manikin,
                         other parameters may be re-defined after test.
▶ Sampling setup
                        Test duration:     597.0  msec =    1500 pts/ch
  Define channels
                       Trigger method:  SOFTWARE  a signal FALLS BELOW
  Amplifiers                                                threshold
                        Start of data:     -99.5  msec
  Transducers                                250  pts   BEFORE  trigger

  Backup card data     Trigger signal:   Ch 15  =  SLED

  Manikin controls          Threshold:      41  mV  = 10.1      G
                                                  BELOW initial level
  Colors and comm.
                       Define sampling rate, durations of pre- and post-test
  Quit to DOS          calibration lengths, pre-trigger delay and duration
                       of test, all depending on the size of CC memory.
```

Figure B-4. Screen printout of the menu to setup the data acquisition sampling rate and the parameters for impact detection and data extraction from the credit card.

```
Test:  LX65-56        MIDAS-3.0   Manikin Integrated DAS          13:07:56

Identify test        (20)                                                A/D
                      ON  Label       Channel description             channel
Extract signals
                      01  AX-HEAD     Head X (forward) accel             01
Process signals       02  AY-HEAD     Head Y (lateral) accel             03
                      03  AZ-HEAD     Head Z (vertical) accel            05
Sampling setup        04  AAY-HEAD    Head Y (pitch) accel               07
                      05  FZ-NECK     Neck Z (vertical) force            09
▶ Define channels     06  FX-NECK     Neck X (forward) force             11
                      07  MY-NECK     Neck Y (pitch) moment              13
Amplifiers            08  AX-T1       T1 X (forward) accel               15
                      09  AY-T1       T1 Y (lateral) accel               17
Transducers           10  AZ-T1       T1 Z (vertical) accel              19
                      11  FZ-T1       T1 Z (vertical) force              21
Backup card data      12  FX-T1       T1 X (forward) force               23
                      13  MY-T1       T1 Y (pitch) moment                25
Manikin controls      14  MX-T1       T1 X (roll) moment                 27
                      15  SLED        Sled (external) accel              29
Colors and comm.
                     Define and describe channels.  Name engineering units
Quit to DOS          for the signals.  Designate signals which are to be
                     extracted, stored, and displayed.
```

Figure B-5. Screen printout of the menu to define channel labels and designate those active channels to be extracted after the test.

```
Test:  LX65-56        MIDAS-3.0   Manikin Integrated DAS          13:09:21

Identify test        (20)          DASS  Correction   Units @
                      Ch  Label    Gain  Exp/actual   no load     Units
Extract signals
                      01 AX-HEAD   100    1.000       .0000       G
Process signals       02 AY-HEAD    25    1.087       .0000       G
                      03 AZ-HEAD   100    1.000       .0000       G
Sampling setup        04 AAY-HEAD  100    1.000       .0000       krad/s2
                      05 FZ-NECK   500    1.000       .0000       kN
Define channels       06 FX-NECK   250    1.000       .0000       kN
                      07 MY-NECK   250    1.000       .0000       kN-m
▶ Amplifiers          08 AX-T1      25    1.000       .0000       G
                      09 AY-T1      20    1.000       .0000       G
Transducers           10 AZ-T1      25    1.000       .0000       G
                      11 FZ-T1    1000    1.000       .0000       kN
Backup card data      12 FX-T1     250    1.000       .0000       kN
                      13 MY-T1     250    1.000       .0000       kN-m
Manikin controls      14 MX-T1     250    1.000       .0000       kN-m
                      15 SLED        1     .1000      .0000       G
Colors and comm.
                     Amplifier gains are defined here before sending them
Quit to DOS          to the DASS in the manikin.  Also, define slopes and
                     intercepts of channel Out/In for correct calibration.
```

Figure B-6. Screen printout of the menu to define the amplifiers gains in the data acquisition system, and to label the engineering units of each active channel.

```
Test:  LX65-56      MIDAS-3.0   Manikin Integrated DAS        13:09:40

  Identify test       (20)            mV / Unit     Units/ADC
                      Ch   Label      (@ gain=1)    (overall)     Units
  Extract signals     ==   =====      ==========    =========     =====
                      01   AX-HEAD     .5050        .2417E-01     G
  Process signals     02   AY-HEAD     .5380        .9076E-01     G
                      03   AZ-HEAD     .5570        .2192E-01     G
  Sampling setup      04   AAY-HEAD   3.960         .3083E-02     krad/s2
                      05   FZ-NECK    1.300         .1878E-02     kN
  Define channels     06   FX-NECK    2.800         .1744E-02     kN
                      07   MY-NECK    85.98         .5679E-04     kN-m
  Amplifiers          08   AX-T1      2.430         .2009E-01     G
                      09   AY-T1      2.440         .2501E-01     G
▶ Transducers         10   AZ-T1      2.440         .2001E-01     G
                      11   FZ-T1       .8913        .1370E-02     kN
  Backup card data    12   FX-T1      2.511         .1945E-02     kN
                      13   MY-T1      47.60         .1026E-03     kN-m
  Manikin controls    14   MX-T1      46.67         .1046E-03     kN-m
                      15   SLED       4.070         .2999         G

  Colors and comm.    Transducers sensitivities (e.g., mV/G) may be edited.
                      Overall factors to convert A/D counts to mechanical
  Quit to DOS         units are shown here for verification.
```

Figure B-7. Screen printout of the menu to enter the transducers sensitivities of the manikin, as supplied by the manufacturers or determined from calibrations.

```
Test:  LX65-56      MIDAS-3.0   Manikin Integrated DAS        13:10:43

  Identify test
                        Page     Save credit card data on backup files
  Extract signals

  Process signals     Backup subdirectory:    C:\NBDL\BACK\

  Sampling setup       Configuration file:    1.INI

  Define channels        Pre-trigger data:    2.PRE

  Amplifiers            Post-trigger data:    3.DAT

  Transducers
                        Esc    Do NOT backup, CANCEL edit changes
▶ Backup card data
                        F1     Do NOT backup, but SAVE file names
  Manikin controls
                        F9     RE-WRITE modified file:    LX65-56.MIF
  Colors and comm.
                      Backup card data using TCREAD.EXE utility to create
  Quit to DOS         pre- & post-trigger (.PRE, .DAT) data files.  Manikin
                      configuration will also be saved on (.CFG) file.
```

Figure B-8. Screen printout of the menu to backup credit card data and other labels and settings for later retrieval and analysis.

```
Test:  LX65-56        MIDAS-3.0    Manikin Integrated DAS        13:11:03
Identify test       F1   send SAMPLING rate and ALL GAINS to DASS
Extract signals     F2   send only SAMPLING rate =  2512 Hz to DASS
Process signals     F3   send GAIN =    100x  <7> to  Ch 01 = AX-HEAD
Sampling setup      F4   request pre-test calibration in DASS
Define channels     F5   MONITOR:  terminal mode over COM2 serial port
Amplifiers          F6   request post-test calibration in DASS
Transducers         F7   future use
Backup card data    F8   send 3 ESC to DASS (to clear hung COM2 port)
▸ Manikin controls  F9   arm manikin (put DASS in acquisition mode)
Colors and comm.
Quit to DOS         Control Panel for manikin:  initializes manikin to
                    specified configuration, arms manikin for trigger
                    detection, and downloads acquired data from card.
```

Figure B-9. Screen printout of the manikin controls menu which allows communication with the manikin internal data acquisition subsystem over serial communication port.

```
Test:  LX65-56        MIDAS-3.0    Manikin Integrated DAS        13:12:08
Identify test       F1   send SAMPLING rate and ALL GAINS to DASS
Extract signals     F2   send only SAMPLING rate =  2512 Hz to DASS
Process signals     F3   send GAIN =    100x  <7> to  Ch 01 = AX-HEAD
Sampling setup      F4   request pre-test calibration in DASS
Define channels     F5   MONITOR:  terminal mode over COM2 serial port
Amplifiers                                     Port   status byte
                                               COM2:    0110 0000
Transducers
Backup card data                                 Del       End
▸ Manikin controls                               clear     exit
                                                 window    monitor
Colors and comm.
Quit to DOS         Control Panel for manikin:  initializes manikin to
                    specified configuration, arms manikin for trigger
                    detection, and downloads acquired data from card.
```

Figure B-10. Screen printout of the manikin controls menu when the "monitor" mode is activated allowing synchronous serial communication with the manikin.

```
Test:  LX65-56     MIDAS-3.0   Manikin Integrated DAS        13:12:32

  Identify test                                    COLORS
                    Static     Lo   Hi       Static        Static
  Extract signals
                    Dynamic    Lo   Hi       Dynamic       Dynamic
  Process signals
                    Buttons    Lo   Hi      Key       Key       Key
  Sampling setup
                    Messages   Lo   Hi      Message       Message
  Define channels
                     F     B   colors
  Amplifiers

  Transducers

  Backup card data

  Manikin controls  Speaker           Port   Baud   Parity  Word   Stop
                     On               COM2   1200   None    8-bit  1-bit
► Colors and comm.
                    Change color scheme of this program, and parameters
  Quit to DOS       of serial port that communicates with the manikin.
```

Figure B-11. Screen printout of the menu to setup the colors and communication port parameters. Choosing colors becomes important for laptop LCD screens.

```
   F1     Raw channels                   F2     Test/channel information

   F3     [1] Cross-plot signals         F4     [2] Over-plot signals

   F5     [3] Integral/derivative        F6     [4] 1st/2nd integrals

   F7     [5] Triax and resultant        F8     [6] Head triax & HIC

   F9     Execute all ◄► functions       F10    VGA:  640x480, 80x30

 Fn  or  Enter  screen output   Alt – Fn  parameters      Tab  form/graph

                                                               Esc  exit

01 = AX-HEAD  = Head X (forward) accel
02 = AY-HEAD  = Head Y (lateral) accel     01   ---------------------
03 = AZ-HEAD  = Head Z (vertical) accel    02   ---------------------
04 = AAY-HEAD = Head Y (pitch) accel       03   ---------------------
05 = FZ-NECK  = Neck Z (vertical) force    05   ---------------------
06 = FX-NECK  = Neck X (forward) force     06   ---------------------
07 = MY-NECK  = Neck Y (pitch) moment      15   ---------------------
08 = AX-T1    = T1 X (forward) accel
09 = AY-T1    = T1 Y (lateral) accel      Analysis span └──────┘   6APRTST3
10 = AZ-T1    = T1 Z (vertical) accel
```

Figure B-12. Screen printout of data processing sub-menu which allows the selection of up to six channels to be graphically displayed, in raw form, on the screen.

```
F1    Raw channels                      F2    Test/channel information
F3    [1] Cross-plot signals            F4    [2] Over-plot signals
F5    [3] Integral/derivative           F6    [4] 1st/2nd integrals
F7    [5] Triax and resultant           F8    [6] Head triax & HIC
F9    Execute all ◄► functions          F10   VGA:  640x480, 80x30

                         Alt – Fn  parameters      Tab  form/graph
Ctrl – Fn  hardcopy output                              Esc  exit

01 = AX-HEAD  = Head X (forward) accel
02 = AY-HEAD  = Head Y (lateral) accel      01 ----------------
03 = AZ-HEAD  = Head Z (vertical) accel
04 = AAY-HEAD = Head Y (pitch) accel        02 ----------------
05 = FZ-NECK  = Neck Z (vertical) force
06 = FX-NECK  = Neck X (forward) force      03 ----------------
07 = MY-NECK  = Neck Y (pitch) moment
08 = AX-T1    = T1 X (forward) accel        04 ----------------
09 = AY-T1    = T1 Y (lateral) accel
10 = AZ-T1    = T1 Z (vertical) accel       HARDCOPY   6APRTST3     ↑A
```

Figure B-13. Screen printout of the data processing submenu allowing the selection of up to four channels to be plotted in portrait format "A" hard copy for quick look.

```
F1    Raw channels                      F2    Test/channel information
F3    [1] Cross-plot signals            F4    [2] Over-plot signals
F5    [3] Integral/derivative           F6    [4] 1st/2nd integrals
F7    [5] Triax and resultant           F8    [6] Head triax & HIC
F9    Execute all ◄► functions          F10   VGA:  640x480, 80x30

                         Alt – Fn  parameters      Tab  form/graph
Ctrl – Fn  hardcopy output                              Esc  exit

01 = AX-HEAD  = Head X (forward) accel      01 ----------------
02 = AY-HEAD  = Head Y (lateral) accel      02 ----------------
03 = AZ-HEAD  = Head Z (vertical) accel     03 ----------------
04 = AAY-HEAD = Head Y (pitch) accel        04 ----------------
05 = FZ-NECK  = Neck Z (vertical) force     05 ----------------
06 = FX-NECK  = Neck X (forward) force      06 ----------------
07 = MY-NECK  = Neck Y (pitch) moment       07 ----------------
08 = AX-T1    = T1 X (forward) accel        08 ----------------
09 = AY-T1    = T1 Y (lateral) accel        09 ----------------
10 = AZ-T1    = T1 Z (vertical) accel       HARDCOPY   6APRTST3     2B
```

Figure B-14. Screen printout of the data processing submenu allowing the selection of up to nine channels to be plotted in portrait format "B" hard copy for quick look.

```
   F1      Raw channels                        F2      Test/channel information
   F3      [1] Cross-plot signals              F4      [2] Over-plot signals
   F5      [3] Integral/derivative             F6      [4] 1st/2nd integrals
   F7      [5] Triax and resultant             F8      [6] Head triax & HIC
   F9      Execute all ◄► functions            F10     VGA:  640x480, 80x30

                                 Alt - Fn  parameters      Tab  form/graph
 Ctrl - Fn  hardcopy output                                     Esc  exit

01 = AX-HEAD  = Head X (forward) accel
02 = AY-HEAD  = Head Y (lateral) accel     01 ---------------------------
03 = AZ-HEAD  = Head Z (vertical) accel
04 = AAY-HEAD = Head Y (pitch) accel       02 ---------------------------
05 = FZ-NECK  = Neck Z (vertical) force
06 = FX-NECK  = Neck X (forward) force     03 ---------------------------
07 = MY-NECK  = Neck Y (pitch) moment
08 = AX-T1    = T1 X (forward) accel       04 ---------------------------
09 = AY-T1    = T1 Y (lateral) accel
10 = AZ-T1    = T1 Z (vertical) accel      HARDCOPY              6APRTST3    ↑C
```

Figure B-15. Screen printout of the data processing submenu allowing the selection of up to four channels to be plotted in landscape format "C" hard copy for quick look.

```
   F1      Raw channels                        F2      Test/channel information
   F3      [1] Cross-plot signals              F4      [2] Over-plot signals
   F5      [3] Integral/derivative             F6      [4] 1st/2nd integrals
   F7      [5] Triax and resultant             F8      [6] Head triax & HIC
   F9      Execute all ◄► functions            F10     VGA:  640x480, 80x30

                                 Alt - Fn  parameters      Tab  form/graph
 Ctrl - Fn  hardcopy output                                     Esc  exit

01 = AX-HEAD  = Head X (forward) accel     01 ---------------------------
02 = AY-HEAD  = Head Y (lateral) accel     02 ---------------------------
03 = AZ-HEAD  = Head Z (vertical) accel    03 ---------------------------
04 = AAY-HEAD = Head Y (pitch) accel       04 ---------------------------
05 = FZ-NECK  = Neck Z (vertical) force    05 ---------------------------
06 = FX-NECK  = Neck X (forward) force     06 ---------------------------
07 = MY-NECK  = Neck Y (pitch) moment      07 ---------------------------
08 = AX-T1    = T1 X (forward) accel       08 ---------------------------
09 = AY-T1    = T1 Y (lateral) accel       09 ---------------------------
10 = AZ-T1    = T1 Z (vertical) accel      HARDCOPY              6APRTST3    2D
```

Figure B-16. Screen printout of the data processing submenu allowing the selection of up to nine channels to be plotted in landscape format "D" hard copy for quick look.

```
F1     Raw channels                        F2     Test/channel information
F3     [1] Cross-plot signals              F4     [2] Over-plot signals
F5     [3] Integral/derivative             F6     [4] 1st/2nd integrals
F7     [5] Triax and resultant             F8     [6] Head triax & HIC
F9     Execute all ◄► functions            F10    VGA:  640x480, 80x30

                          Alt - Fn  parameters       Tab  form/graph
Ctrl - Fn  hardcopy output                                Esc  exit

01 = AX-HEAD   = Head X (forward) accel
02 = AY-HEAD   = Head Y (lateral) accel     01 -----------    05 -----------
03 = AZ-HEAD   = Head Z (vertical) accel
04 = AAY-HEAD  = Head Y (pitch) accel       02 -----------    06 -----------
05 = FZ-NECK   = Neck Z (vertical) force
06 = FX-NECK   = Neck X (forward) force     03 -----------    07 -----------
07 = MY-NECK   = Neck Y (pitch) moment
08 = AX-T1     = T1 X (forward) accel       04 -----------    08 -----------
09 = AY-T1     = T1 Y (lateral) accel
10 = AZ-T1     = T1 Z (vertical) accel      HARDCOPY              6APRTST3    3E
```

Figure B-17. Screen printout of the data processing submenu allowing the selection of up to eight channels to be plotted in two columns in landscape format "E" hard copy for quick look.

```
F1     Raw channels                        F2     Test/channel information
F3     [1] Cross-plot signals              F4     [2] Over-plot signals
F5     [3] Integral/derivative             F6     [4] 1st/2nd integrals
F7     [5] Triax and resultant             F8     [6] Head triax & HIC
F9     Execute all ◄► functions            F10    VGA:  640x480, 80x30

                          Alt - Fn  parameters       Tab  form/graph
Ctrl - Fn  hardcopy output                                Esc  exit

01 = AX-HEAD   = Head X (forward) accel     01 -----------    10 -----------
02 = AY-HEAD   = Head Y (lateral) accel     02 -----------    11 -----------
03 = AZ-HEAD   = Head Z (vertical) accel    03 -----------    12 -----------
04 = AAY-HEAD  = Head Y (pitch) accel       04 -----------    13 -----------
05 = FZ-NECK   = Neck Z (vertical) force    05 -----------    14 -----------
06 = FX-NECK   = Neck X (forward) force     06 -----------    15 -----------
07 = MY-NECK   = Neck Y (pitch) moment      07 -----------    16 -----------
08 = AX-T1     = T1 X (forward) accel       08 -----------    17 -----------
09 = AY-T1     = T1 Y (lateral) accel       09 -----------    18 -----------
10 = AZ-T1     = T1 Z (vertical) accel      HARDCOPY              6APRTST3    1F
```

Figure B-18. Screen printout of the data processing sub-menu allowing the selection of up to 18 channels to be plotted in landscape format "F" hard copy for quick look.

```
F1     Raw channels                       ◄► F2     Test/channel information
F3     [3] Integral/derivative               F4     [2] Over-plot signals
F5     [3] Integral/derivative               F6     [2] Over-plot signals
F7     [1] Cross-plot signals                F8     [2] Over-plot signals
F9     Execute all ◄► functions              F10    VGA:  640x480, 80x30

Ctrl - Fn  hardcopy output       Ins  mark for hardcopy          Esc  exit

      Test  LX65-56          1500 pts @  2512.5 Hz =  597.0 ms long

      Descript.:  Dynamic testing of MIDAS prototype crash manikin
                  Sled acceleration pulse:  10.3 peak G, 23.1 mph
                  Seat pitch:  +35 degrees

                                  Analysis:    59.7 ms
      20 channels:  01 - 20           Span:      .0 to     59.7 ms.
```

Figure B-19. Screen printout of the data processing submenu showing test information and allowing the printing of hard copy of pertinent information.

```
      F1     Raw channels                     F2     Test/channel information
      F3     [3] Integral/derivative          F4     [2] Over-plot signals
  ◄►  F5     [3] Integral/derivative          F6     [2] Over-plot signals
      F7     [1] Cross-plot signals           F8     [2] Over-plot signals
      F9     Execute all ◄► functions         F10    VGA:  640x480, 80x30

 Fn  or  Enter  screen output     Alt - Fn  parameters        Tab  form/graph
 Ctrl - Fn  hardcopy output       Ins  mark for hardcopy          Esc  exit

Signals:  05 FZ-NECK              First integral          First derivative
                                  times   1.0000          times   1.0000
 Filter:   100  Hz
  (LP)      24  dB/oct        Set  integral BEG.  = 0

 Labels:  Head axial (Z) force                            Head Z
          (kN)                                            (G)
LX65-56
Caption:  7 Gx run, WITHOUT cushion
```

Figure B-20. Screen printout of the data processing submenu showing (bottom third) parameters for integral/derivative analysis and allowing the user to modify the parameters.

F1	Raw channels		F2	Test/channel information
F3	[3] Integral/derivative	◄►	F4	[2] Over-plot signals
F5	[3] Integral/derivative		F6	[2] Over-plot signals
F7	[1] Cross-plot signals		F8	[2] Over-plot signals
F9	Execute all ◄► functions		F10	VGA: 640x480, 80x30

```
Fn  or  Enter  screen output      Alt – Fn  parameters       Tab  form/graph
Ctrl – Fn  hardcopy output        Ins  mark for hardcopy          Esc  exit

Signals:  10 AZ-T1       (Left vertical)      00 Seat pit   (Right vertical)

Filter:   100  Hz
 (LP)      24  dB/oct

Labels:   Neck (C1) axial force
          (kN)
LX65-56
Caption:  7 Gx run WITHOUT cushion
```

Figure B-21. Screen printout of the data processing submenu showing parameters for over-plot of two signals. This analysis also allows plotting of a single channel.

	F1	Raw channels	F2	Test/channel information
	F3	[3] Integral/derivative	F4	[2] Over-plot signals
	F5	[3] Integral/derivative	F6	[2] Over-plot signals
◄►	F7	[5] Triax and resultant	F8	[2] Over-plot signals
	F9	Execute all ◄► functions	F10	VGA: 640x480, 80x30

```
Fn  or  Enter  screen output      Alt – Fn  parameters       Tab  form/graph
Ctrl – Fn  hardcopy output        Ins  mark for hardcopy          Esc  exit

Signals:  01 AX-HEAD     02 AY-HEAD     03 AZ-HEAD       Tri-axial resultant

Filter:   100  Hz
 (LP)      24  dB/oct

Labels:   Head X         Head Y         Head Z           Head resultant accel
          (G)            (G)            (G)              (G)
LX65-56
Caption:  7 Gx run WITHOUT   cushion
```

Figure B-22. Screen printout of the data processing submenu showing (bottom third) the parameters selected to analyze a triaxial cluster of transducers.

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